

WHAT IS CLAIMED

- 1) A device for producing an opening or cavity in the side of a ceramic product during product molding in a mould, the mould having a molding cavity delimited by a molding surface which has a window, the device comprising a punch joined on the window in such a way that it projects into or retracts from the molding cavity, wherein the punch is expandable with variations in its rigidity; the device comprising punch shape variation differential constriction means; and actuator means for punch deformation which, in the active condition, are designed to cause the punch to change shape against the opposing reaction of the constriction means; the constriction means and the actuator means producing a controlled anisotropic deformation of the punch, so that the punch projects into the molding cavity.
- 2) The device according to claim 1, wherein the punch comprises a cover with an inner cavity designed to contain a fluid substance, the cover being deformable due to the action of the fluid

substance which it contains; the actuator means changing the shape of the cover against the opposing reaction of the constriction means designed to make the punch project into the molding cavity.

3) The device according to claim 2, wherein the internal cavity is closed to prevent exchanges of the fluid substance with the environment outside the cavity.

4) The device according to claim 2, wherein the cavity is open to allow exchanges of the fluid substance with the environment outside the cavity.

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5) The device according to any of the claims from 2 to 4, wherein the fluid substance is gaseous.

6) The device according to any of the claims from 2 to 4, wherein the fluid substance is a liquid.

7) The device according to any of the claims from 2 to 4, wherein the fluid substance is a loose solid substance.

8) The device according to claim 7, wherein the loose solid substance is a finely separated powder.

9) The device according to any of the claims from 2 to 4, wherein the fluid substance is a gelatinous substance.

10) The device according to claim 2, wherein the cover is expandable due to a pressure difference acting between the internal fluid substance and the environment outside the cavity.

11) The device according to claim 10, wherein the cover is made of an elastic material.

12) The device according to claim 10, wherein the cover is made of a material with deformability which varies according to the direction of deformation, the differential constriction means being made of the same material as the cover.

13) The device according to claim 12, wherein the cover includes a framework designed to give the cover a preset anisotropic deformation capacity.

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14) ~~The device according to any of the foregoing claims, wherein the cover has a plurality of projections which can be attached to a matching plurality of windows.~~

15) The device according to claim 14, wherein a single cavity is controlled by the projections in such a way as to project the punches into the molding cavity or retract them from the molding cavity.

16) The device according to claim 14, comprising a plurality of cavities controlled by the projections so as to project the punches into the molding cavity or retract them from the molding cavity.

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17) ~~The device according to claim 1 or 16, wherein the punch has a casing of suitable thickness for covering the cover, at least partially.~~

18) The device according to claim 17, wherein the casing is made at least partially of an elastomeric material.

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- 19) The device according to claim 18, wherein the elastomeric material is a silicone rubber.
- 20) The device according to claim 17, wherein the casing is made of metal.
- 21) The device according to any of the claims from 17 to 20, wherein the casing incorporates at least one insert made of a suitable material.
- 22) The device according to any of the claims from 17 to 20, wherein the casing is covered by a cap made of a suitable material.
- 23) The device according to any of the claims from 17 to 20, wherein the casing (16) and the cover (12) are integral, forming a single body.
- 24) The device according to claim 1, wherein the punch is fitted with a suitably thick casing (16).
- 25) The device according to claim 24, wherein the casing (16) is made of an elastomeric material.

26) The device according to claim 25, wherein the elastomeric material is a silicone rubber.

27) The device according to claim 24, wherein the casing (16) is at least partially made of metal.

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28) The device according to any of the claims from 24 to 27, wherein the casing (16) incorporates at least one insert (31) made of a suitable material.

29) The device according to claim 28, wherein the insert (31) is made of a material which is resistant to abrasions.

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30) The device according to any of the claims from 24 to 28, wherein the casing (16) is covered by a cap (34) made of a suitable material.

31) The device according to any of the claims from 24 to 30, wherein at least the casing (16) of the punch is made from a material with deformability which varies according to the direction of deformation, the differential constriction means being made of the same material as the casing.

32) The device according to claim 31, wherein the casing of the punch includes a framework designed to give the casing an anisotropic deformation capacity.

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33) The device according to any of the claims from 24 to 32, wherein the casing has a plurality of projections which can be attached to a plurality of windows.

34) The device according to claim 1, wherein the punch shape variation differential constriction means consist of a seat in the body of the mould, delimited by rigid bordering walls 10), attached to the window and housing the punch, the rigid walls counteracting the punch deformation and making part of the punch exit the window and move into the molding cavity of the mould, at a position corresponding to the opening or cavity in the ceramic product being made.

35) The device according to claim 34, wherein the seat has a tubular configuration and has a closing base wall, located in a position opposite that of the window.

- 36) The device according to claim 35, wherein the seat is cylindrical in shape.
- 37) The device according to claim 36, wherein the cylindrical shape of the seat has an elliptical cross-section.
- 38) The device according to claim 35, wherein the seat is prismatic in shape.
- 39) The device according to claim 35, wherein the seat is prismatic with a star-shaped base.
- 40) The device according to claim 1, wherein the punch shape variation differential constriction means comprise a cage or case which encompasses the punch along at least part of its side surface, counteracting its deformation, leaving the punch free to expand along a punch axial direction.
- 41) The device according to claim 40, wherein the cage or case includes at least one ring designed to circumscribe the cover.



42) The device according to claim 41, wherein each of the rings has a circular cross-section.

Sub A9 } 43) ~~The device according to claim 40 or 41, wherein the cage or case is made of an antifriction material.~~

44) The device according to claim 43, wherein the antifriction material is a tetrafluoropolyethylene material.

Sub A10 } 45) ~~The device according to any of the claims from 34 to 44, wherein the cage or case is housed in the seat.~~

46) ~~The device according to any of the claims from 34 to 45, wherein the seat has a variable cross-section, there being a cover with correspondingly variable cross-section housed in the seat.~~

47) The device according to claim 1, wherein the actuator means are designed to exert a localized contact pressure on part of the outer surface of the punch, the pressure being intended to produce a corresponding deformation of another part of

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the punch and the consequent punch projection into or retraction from the molding cavity.

48) The device according to claim 47, wherein the actuator means operate with a fluid substance which cannot be compressed.

49) The device according to claim 47, wherein the actuator means operate with a fluid substance which can be compressed.

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50) The device according to any of the claims from 2 to 23, wherein the actuator means comprise a delivery pipe which communicates with the cover internal cavity; and pressurized fluid substance generator means connected to the delivery pipe.

51) The device according to claim 50, wherein the actuator means comprise valve means for the delivery pipe, operating between two opposite conditions, in one of which they prevent any reflux to the outside of the fluid contained in the cover cavity.

52) The device according to claim 2, comprising means for free retraction of the punch behind the

molding surface, being designed to depress the cover and draw the punch out of the molding cavity, if the cover internal cavity is not pressurized.

- 53) The device according to claim 52, wherein the cover is made of an elastic material, the free retraction means consisting of the spontaneous elastic contraction of the material used to make the cover following depressurization of its internal cavity.
- 54) The device according to claim 2, comprising means for the forced retraction of the punch below the molding surface, being designed to apply to the punch, from the outside, a vacuum suitable for drawing the punch back into the seat.
- 55) The device according to claim 54, wherein the forced retraction means comprise means for generating a vacuum inside the cover cavity.